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For the President of the European Patent Office

Le Président de l'Office européen des brevets
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R C van Dijk



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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
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Cable terminating apparatus and method

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CABLE TERMINATING APPARATUS AND METHOD

The present invention relates to apparatus for terminating an electrical cable with a connector and a method of performing such a termination.

When there is a requirement in the field to terminate a cable containing a plurality of wires with a connector containing a plurality of terminals, the operation can be difficult to perform particularly if the cable is of the type typically used for telecommunications applications which normally contain a significant number of small diameter wires. Prior art tool for such termination operations involve inserting wires one at a time into connector terminals are made of plastic and accordingly do not last well and necessitate cutting redundant ends of the wires off by pliers which leaves wire ends of variable length which can touch a shielding member. An object of the invention is to facilitate such an operation. A further preferable object of the invention is to ensure that when such termination has occurred redundant wire ends do not protrude from the connector in such a manner that the application of a strain relief member to the connector is impeded in any way. A further preferable object is to provide a device which cuts redundant ends of the wires off close to the connector terminals in a convenient manner. A still further object is to provide a device which inserts all wires to a uniform controlled depth into the terminals which may be insulation displacement type contacts.

Thus according to the invention there is provided a device for positioning a plurality of wires of a cable relative to each other and terminating the cable with a connector by connecting the wires to terminals of the

connector, the device comprising a support means with positioning means for positioning wires of the cable in a fixed spaced relationship relative to each other and a guide means for engaging a complementary surface of the connector as it engages the device so as to guide terminals of the connector into electrically contacting relationship with the wires.

Preferably the positioning means comprises one or more slots in walls of the support means and more preferably the positioning means comprises at least two slots between which at least one of the wires for connection to a single terminal of the connector is positionable.

In order to facilitate the insertion of the wires into the terminals, which may be of the insulation displacement type, the support means preferably includes pushing means substantially aligned with the path of each wire as determined by the wire positioning means. Conveniently the pushing means comprises a wall substantially aligned with the path of each wire as determined by the wire positioning means. So that each terminal can be securely terminated to the appropriate wire each pushing means wall preferably includes a slot for accommodating a terminal of a connector which is fully engaged with the support means.

Conveniently the guide means for engaging a complementary surface of the connector comprises an inner surface of the support means.

Preferably the support means includes two housing parts that are interengagable so as to grip the cable in order that the cable can be held firmly so that no strain will be applied to the wires as the termination process occurs.

In order to avoid the requirement to cut redundant wire ends off after the termination process has been completed preferably the device includes cutting means for severing

the wires after the wires have been fully engaged by the terminals. The cutting means preferably includes at least one blade which is reciprocally mounted relative to the support means and configured to sever a plurality of wires substantially simultaneously.

Conveniently the or each blade is movable from a non-cutting position to a cutting position by means of a part of the blade which projects from the support means.

Apparatus for performing the above mentioned operation conveniently also includes a squeezing tool including means for urging the connector into full engagement with the support means which preferably includes reaction means for restraining one of the support means and the connector as the other is urged into engagement therewith.

So that the apparatus can be used to perform the terminating and severing operations, preferably the apparatus is configurable between a first configuration in which cutting means of the device is not actuated upon urging of the connector towards the device and a second configuration in which it is so actuated to sever redundant portions of the wires from remaining portions thereof.

Preferably the cutting means includes at least one blade and the squeezing tool includes a rebated portion into which a portion of the blade is selectively positionable depending on which configuration the apparatus is in.

According to a second aspect of the invention there is provided a method of terminating a cable having a plurality of wires with a connector having a plurality of terminals comprising the steps of:

(i) removing a portion of outer insulation from the cable to expose insulated wires therewithin;

(ii)positioning the insulated wires by engaging them with positioning means of a support means;

(iii)aligning the connector with the support means by engagement of guide means of the support means with a complementary surface of the connector;

(iv)urging the connector further into engagement with the support means and thereby bringing the terminals into contacting relationship with the wires; and

(v)removing the support means from the cable terminated with the connector.

The method preferably also includes the further step of cutting off redundant ends of the wires with cutting means connected to the support means.

The method preferably also includes the step of placing the aligned connector and support means in a squeezing tool and performing the urging step iv by means of the squeezing tool.

The method preferably also includes the further step of reconfiguring the support means and squeezing tool from a first configuration for performing the urging procedure of step iv to a second configuration and performing a second urging step with the squeezing tool to effect the cutting off of the redundant wire ends with the cutting means.

The invention will now be described by way of example only with reference to the accompanying drawings in which:

Fig 1 shows a perspective view of a cable manager device forming part of the inventive apparatus;

Fig 2 shows a perspective view of the cable manager device in an opened state;

Fig 3 shows an exploded perspective view of the cable manager device;

Fig 4 shows a plan view of the cable manager device from below;

Fig 5 shows a perspective view from below of the cable manager device;

Fig 6 shows a perspective view of a cutting blade of the cable manager device in isolation;

Fig 7 shows a perspective view of the cable manager device with a cable installed therein ready for termination with a connector;

Fig 8 shows a perspective view of the cable manager device with installed cable and partly engaged connector;

Fig 9 shows a perspective view of the cable manager device and connector loaded into a squeezing tool;

Fig 10 shows a perspective view of the installed connector encased in a shield;

Fig 11 is a photograph showing the cable manager device and connector being loaded into the squeezing tool;

Fig 12 is a photograph showing the position of the cable manager device relative to the squeezing tool during a first squeezing operation;

Fig 13 is a photograph showing the position of the cable manager device relative to the squeezing tool during a second squeezing operation;

Fig 14 is a photograph showing separation of the cable manager device from the connector;

Fig 15 is a photograph showing disengagement of the cable manager device from the cable; and

Fig 16 is a photograph showing the cable terminated with the connector complete with a strain relief device.

The apparatus according to the invention comprises a cable organiser 2 and a squeezing tool 4 which are used to terminate a cable 6 with a connector 8 by means of inserting individual wires 10 of the cable 6 into insulation displacement slots 12 of contacts 14 in the connector. Opposite ends of the contacts 14 are

positioned so as to be engageable from a mating face 16 of the connector 8 by means of a complementary connector (not shown).

The cable manager 2 includes two housing parts 18 which are hingeably interconnected by means of a pivot pin 20 which passes through aligned holes 22 in pivot pin lugs 24 projecting from the housing parts 18. Complementary locking pin lugs 26 are provided on the opposite sides of the housing parts 18 to those on which the pivot pin lugs are provided. The two housing parts 18 are held in their closed position, shown for example in fig 7, by means of a locking pin 30. Confronting inwardly facing surfaces of each housing part 18 between the lugs 24 and 26 include a hemi-cylindrical cable gripping recess 32 defined by an inner side wall 36 including four U-shaped wire guiding or lacing slots 40 which open towards a front end 34 of the housing part 18. The opposite or outer side of each housing part 18 is defined by an outer side wall 38 which also includes four similar wire guiding slots 42 which open towards the front end 34 of the housing part 18. Each inner wall slot 40 is aligned with a corresponding outer wall slot 42. The width of each slot 40 and 42 is designed to snugly accommodate a wire including its insulation covering.

A wire pushing wall 44 extends perpendicularly to the inner and outer side walls 36 and 38 adjacent to each pair of aligned inner and outer slots 40 and 42. Each wire pushing wall 44 includes a U-shaped slot 46 which permits the corresponding insulation displacement contact 14 to be to be fully engaged with the relevant wire 10.

Each housing part 18 includes a blade slot 48 positioned close to and parallel to its outer side wall clearly shown in figure 4. The blade slot 48 slidably

accommodates a blade 50 having a cutting edge 52 which is arranged so that when a blade rear end 54 is moved to a position in which it is flush with a rear face 56 of the housing part 18 the cutting edge 52 severs wires extending through the wire guiding slots 42 in the housing outer side wall. The end of each slot 42 is defined by a relatively large radius of curvature portion 66 and a relatively small radius of curvature portion 68. The side of each blade 50 has correspondingly radiused portions 67 (larger radius) and 69 (smaller radius) so that each blade can only be installed in its housing part 18 one way round. This ensures that the cutting edge 52 of each blade 50 is situated so as to cut the wires off with the required minimum amount projecting through the contacts in the connector 8. A blade retainer in the form of a slotted spring pin 60 is force fitted in a pin hole 62 in the outer side wall 38 of each housing part 18 and passes through an elongate aperture 58 in the corresponding blade 50 such that the blade is prevented from becoming detached from the housing part 18 but is able to slide towards and away from the front end 34 of the cable manager 2.

An indicator panel 64 extends along each outer side wall 38 adjacent to the wire guiding slots 42 and includes indicia corresponding to the colour of the insulation on the wire to be inserted into each slot 42.

The squeezing tool 4 shown in figure 9 includes a handle 74 to which a trigger 76 is connected by means of a pivot pin 78. Projecting forwardly from the handle 74 is a frame 80 including a U-shaped receiving slot 84 that is adapted to receive the cable manager 2 and connector 8 as described in more detail below. A distal wall 86 of the frame 80 includes an upwardly open gap 82 for receiving the cable 6. It should be noted that the width of the gap

82 is significantly larger than the diameter of the cable that the apparatus is designed to terminate. This can be seen clearly from Figs 11, 12 and 13. A squeezing head 88 is mounted in a proximal end of the frame 80 and is displaceable in the direction A by movement of the trigger 76 towards the handle 74 so as to move slightly into the receiving slot 84. A proximal face 92 of the distal wall 86 includes two rebated regions or slots 90 which are dimensioned to receive the blade rear ends 54 when the cable manager 2 is in a first lateral position relative to the frame 80 as shown in Fig 12. Thus the space between the rebated regions corresponds to that between the blades 50. Laterally adjacent to and on the same side of each rebated region 90 is a support face 94. The lateral distance between the two support faces 94 is also the same as that between the blades 50.

The use of the cable manager 2 and squeezing tool 4 to terminate a cable 6 with a connector 8 will now be described.

A strain relief member 96 shown in Fig 16 is slipped over the end of the cable 6 and an appropriate length of an outer insulation 98 of the cable 6 is stripped off so as to expose insulated inner wires 10 of the cable. In the example shown the cable 6 includes eight wires 10. The invention is of course applicable to cables and connectors having different numbers of wires and contacts.

The locking pin 30 is removed from the cable manager and the cable manager is opened as shown in Fig 2. The cable manager 2 is then closed around the cable with an end portion of the outer insulation 98 clamped between the cable recesses 32 of the housing parts 18 and the locking pin 30 is replaced in the aligned holes 28 in the locking pin lugs 26 to hold the cable 6 firmly gripped in the

cable manager 2.

As shown in Fig 7 each wire 10 is then laced through one of the slots 40 in the inner side wall 36 and through the corresponding aligned slot 42 in the outer side wall 38. So that an operator will know which slots to lace each wire through, the indicator panel 64 includes colour markings which correspond to the colours of the insulation on the wires to be laced through particular slots. As this is done the blades 50 are forced into the housing parts 18 so that their rear ends 54 project from the rear faces 56 thereof. The blades could alternatively be moved to these positions prior to installing the cable 6 in the cable manager 2.

The connector 8 to be used to terminate the cable 6 has a mating face 16 and contacts 14, each with an insulation displacement slot 12, projecting from an opposite connection end 100. The connector is partially engaged with the wires 10 by pushing the connector's connection end 100 slightly into the cable manager 2 as shown in Fig 8. An outer surface of the connector body 104 engages inner surfaces 105 of the housing parts thereby aligning the contacts with contact portions 106 of the wires. As this occurs, the contact portion 106 of each wire 10 extending between the inner and outer walls 36 and 38 and adjacent to the corresponding pushing wall 44 enters a distal portion of the corresponding insulation displacement slot 12. A body 104 of the connector 8 and the internal form of the cable manager 2 may be complementarily configured so that the connector 8 can only be engaged with the cable manager 2 in one orientation. Alternatively the cable manager can bear a label or other indicator for showing which way round the connector needs to be engaged with the cable manager.

As shown in Figs 9, 11 and 12 the cable manager 2 and connector 8 are then placed in the receiving slot 84 of the squeezing tool 4 with the squeezing head 88 in the retracted position (moved towards the handle 74) and with the rear face 56 of the cable manager 2 facing the support face 94 of the distal wall 86 of the frame 80. The frame 80 is configured such that the connector and cable manager can only be placed in the squeezing tool in one orientation. The cable 6 is moved laterally in the gap 82 to the position shown in Fig 11 in which the projecting blade rear ends 54 are aligned with the rebated regions 90 in the distal wall 86 and the connector 8 and cable manager 2 are moved so as to insert the blade rear ends 54 into the rebates 90 as shown in Fig 12.

The trigger 76 is then squeezed so that the squeezing head 88 moves in the direction of arrow A and thereby forces the connector fully into engagement with the connector 8. As this occurs, each wire is pushed further into the appropriate slot 12 in one of the insulation displacement contacts 14. This process is assisted by the presence of one of the pushing walls 44 that is situated adjacent to the contact portion 106 of each of the wires 10. Movement of the cable manager 2 distally of the frame 80 is resisted by its rear face 56 bearing on the support faces 94 of the distal wall 86. No force is applied to the blade rear ends 54 because they are accommodated in the rebated regions 90.

As shown in Fig 13 the trigger 76 is then released and the cable manager 2 and connector 8 are moved proximally by a small distance so that they can be laterally displaced by a small distance to the position shown in Fig 13 in which the blade rear ends 54 are aligned with the support faces 94 and not with the rebated regions 90. A

second squeezing of the trigger 76 is then effected which causes the squeezing head 88 to displace the cable manager and connector distally in the frame 80. As this occurs, the blade rear ends 54 are forced into alignment with the rear face 56 of the cable manager 2 and the cutting edges 52 of the blades 50 sever the wires 10 leaving only the minimum required length of wire projecting outwardly from each insulation displacement contact 14.

The trigger 76 is then released again and the cable manager 2 and connector 8 are removed from the squeezing tool 4 so that the cable manager can be removed from the cable 6 after the locking pin 30 has been removed as shown in Figs 14 and 15. Free ends 108 of the wires 10 which have been severed from the remaining portions thereof are retained in the guiding slots 42 of the cable manager 2 and can simply be pulled out therefrom for disposal.

The strain relief member 110 is then slid up the cable 6 and over the connection end 100 of the connector 8 as shown in Fig 16. This operation will be facilitated by the fact that the redundant ends of the wires have been severed close to the connector.

If necessary a metal shield 112 can be folded around the connector 8 as shown in Fig 10 in a manner well known in the art. The outer surface of the shield 112 will be arranged to project a distance 116 of 0.5 mm outside an outer surface of the connector body 104.

In the example shown in the Figs the connector 8 includes a dust cover 114. The frame 80 of the squeezing tool 4 is however adapted to be used with a connector with or without a dust cover.

More than one wire could be inserted into a particular terminal and/or not all terminals may be engaged by a wire.

The apparatus is preferably adapted to terminate a cable with a shielded or unshielded SL series 110 connector modular jack.

The termination can alternatively be performed in one step by omitting the step shown in Figs 11 and 12 and placing the cable manager in the squeezing tool in the manner shown in Fig 13 straight away.

The cable manager and/or squeezing tool are preferably made of metal and can accordingly be used hundreds or even thousands of times.

The use of the device/apparatus according to the invention leading to a very low rejection rate.

CLAIMS

1.A device (2) for positioning a plurality of wires (10) of a cable (6) relative to each other and terminating the cable with a connector (8) by connecting the wires to terminals (14) of the connector, the device comprising a support means (18) with positioning means (40, 42) for positioning wires of the cable in a fixed spaced relationship relative to each other and a guide means (105) for engaging a complementary surface of the connector as it engages the device so as to guide terminals of the connector into electrically contacting relationship with the wires.

2.The device according to claim 1 wherein the positioning means comprises one or more slots (40, 42) in walls (36, 38) of the support means (18).

3.The device according to claim 2 wherein the positioning means comprises at least two slots (40, 42) between which at least one of the wires (10) for connection to a single terminal of the connector (8) is positionable.

4.The device according to any preceding claim wherein the support means (18) includes pushing means (44) substantially aligned with the path of each wire (10) as determined by the wire positioning means (40, 42).

5.The device according to claim 4 wherein the pushing means comprises a wall (44) substantially aligned with the path of each wire (10) as determined by the wire positioning means (40, 42).

6.The device according to claim 5 wherein each pushing means wall (44) includes a slot (46) for accommodating a terminal (14) of a (8) connector which is fully engaged with the support means (18).

7.The device according to any preceding claim wherein the guide means (105) for engaging a complementary surface of the connector (8) comprises an inner surface of the support means (18).

8.The device according to any preceding claim wherein the support means includes two housing parts (18) that are interengagable so as to grip the cable (6).

9.The device according to any preceding claim including cutting means (50) for severing the wires (10) after the wires have been fully engaged by the terminals (14).

10.The device according to claim 9 wherein the cutting means includes at least one blade (50) which is reciprocally mounted relative to the support means (18) and configured to sever a plurality of wires (10) substantially simultaneously.

11.The device according to claim 10 wherein the or each blade (50) is movable from a non-cutting position to a cutting position by means of a part (54) of the blade which projects from the support means (18).

12.Apparatus for positioning a plurality of wires (10) of a cable (6) relative to each other and terminating the cable with a connector (8) by connecting the wires to

terminals (14) of the connector wherein the apparatus comprises a device (2) according to any preceding claim and a squeezing tool (4) including means (88) for urging the connector into full engagement with the support means.

13.The apparatus according to claim 12 wherein the squeezing tool (4) includes reaction means (86) for restraining one of the support means (18) and the connector (8) as the other is urged into engagement therewith.

14.The apparatus according to claim 13 wherein the apparatus is configurable between a first configuration in which cutting means (50) of the device is not actuated upon urging of the connector (8) towards the device (2) and a second configuration in which it is so actuated to sever redundant portions of the wires (10) from remaining portions thereof.

15.The apparatus according to claim 14 wherein the cutting means includes at least one blade (50) and the squeezing tool (4) includes a rebated portion (90) into which a portion (54) of the blade is selectively positionable depending on which configuration the apparatus is in.

16.A method of terminating a cable (6) having a plurality of wires (10) with a connector (8) having a plurality of terminals (14) comprising the steps of:

- (i) removing a portion of outer insulation (98) from the cable (6) to expose insulated wires (10) therewithin;
- (ii) positioning the insulated wires by engaging them with positioning means (40, 42) of a support means (18);

(iii)aligning the connector with the support means by engagement of guide means (105) of the support means with a complementary surface of the connector;
(iv)urging the connector further into engagement with the support means and thereby bringing the terminals into contacting relationship with the wires; and
(v)removing the support means from the cable terminated with the connector.

17.The method according to claim 16 including the further step of cutting off redundant ends of the wires with cutting means (50) connected to the support means (18).

18.The method according to claim 16 or 17 including the step of placing the aligned connector (8) and support means (18) in a squeezing tool (4) and performing the urging step iv by means of the squeezing tool.

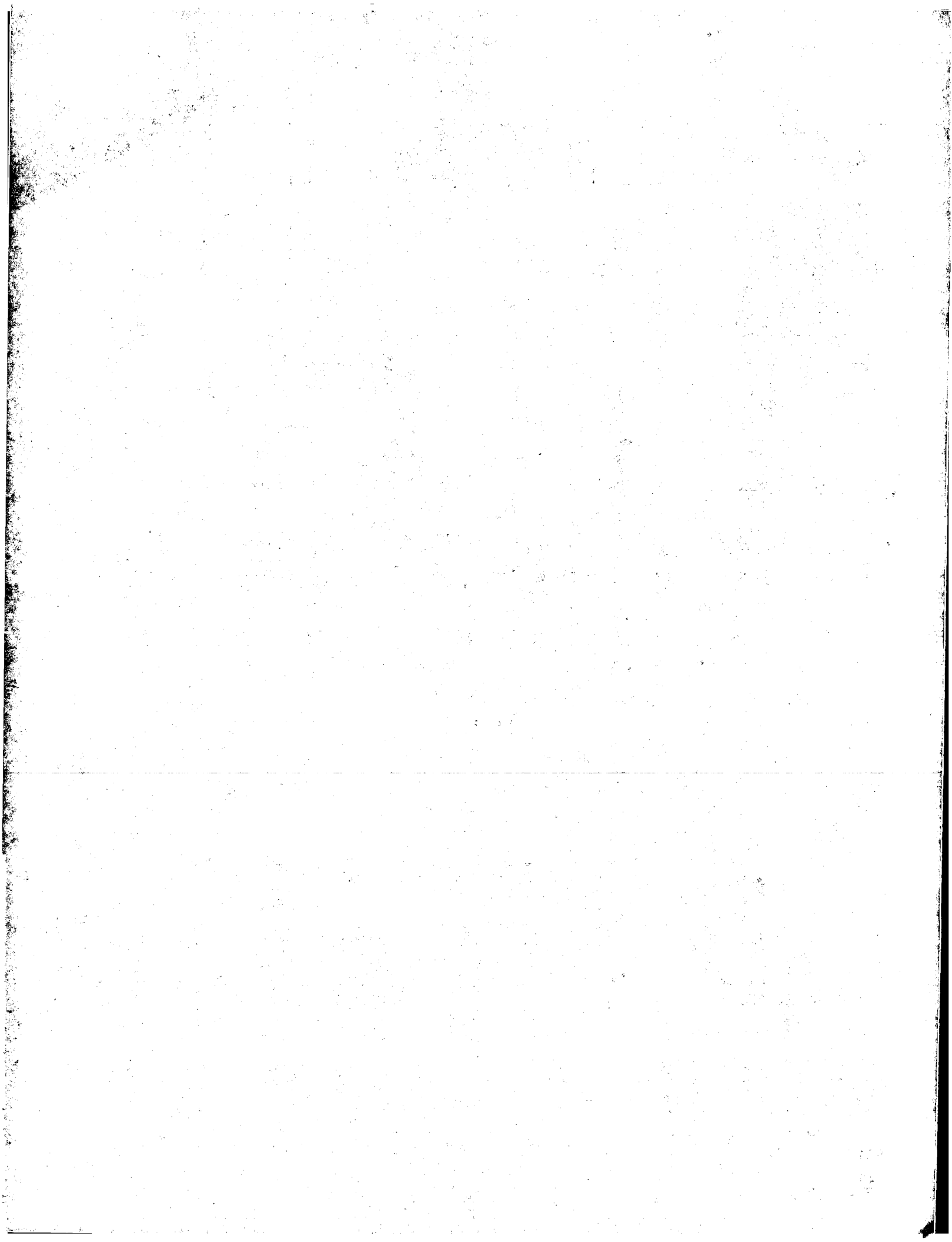
19.Te method according to claims 17 and 18 including the further step of reconfiguring the support means and squeezing tool from a first configuration for performing the urging procedure of step iv to a second configuration and performing a second urging step with the squeezing tool (4) to effect the cutting off of the redundant wire ends with the cutting means (50).

ABSTRACT

CABLE TERMINATING APPARATUS AND METHOD

A device (2) for holding a plurality of wires (10) of a cable (6) in fixed positions relative to each other for assisting in the termination of the cable (6) with a connector having plurality of contacts possibly of the insulation displacement type. The device (2) includes two housing parts (18) which are hingeably connected and between which an end portion of the cable is clamped. Insulated portions of the wires (10) are threaded through guiding slots (40, 42) in inner and outer walls of the housing parts (18) and supported by walls which act to force the wires (10) into slots in insulation displacement contacts of the connector. Slots in the support walls permit the contacts to fully engage the wires. Two blades are reciprocally mounted in the housing parts (18) and each can be advanced by pushing on an end portion thereof to cut redundant portions of the wires off. Squeezing is effected by a pistol type tool for effecting the termination and severing operations.

(Fig 7)



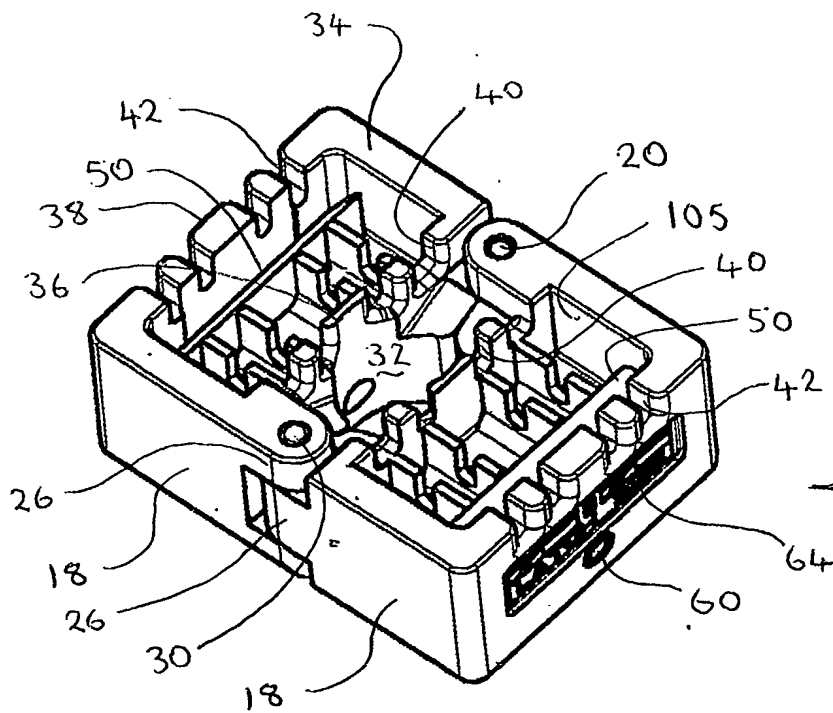


FIG. 1

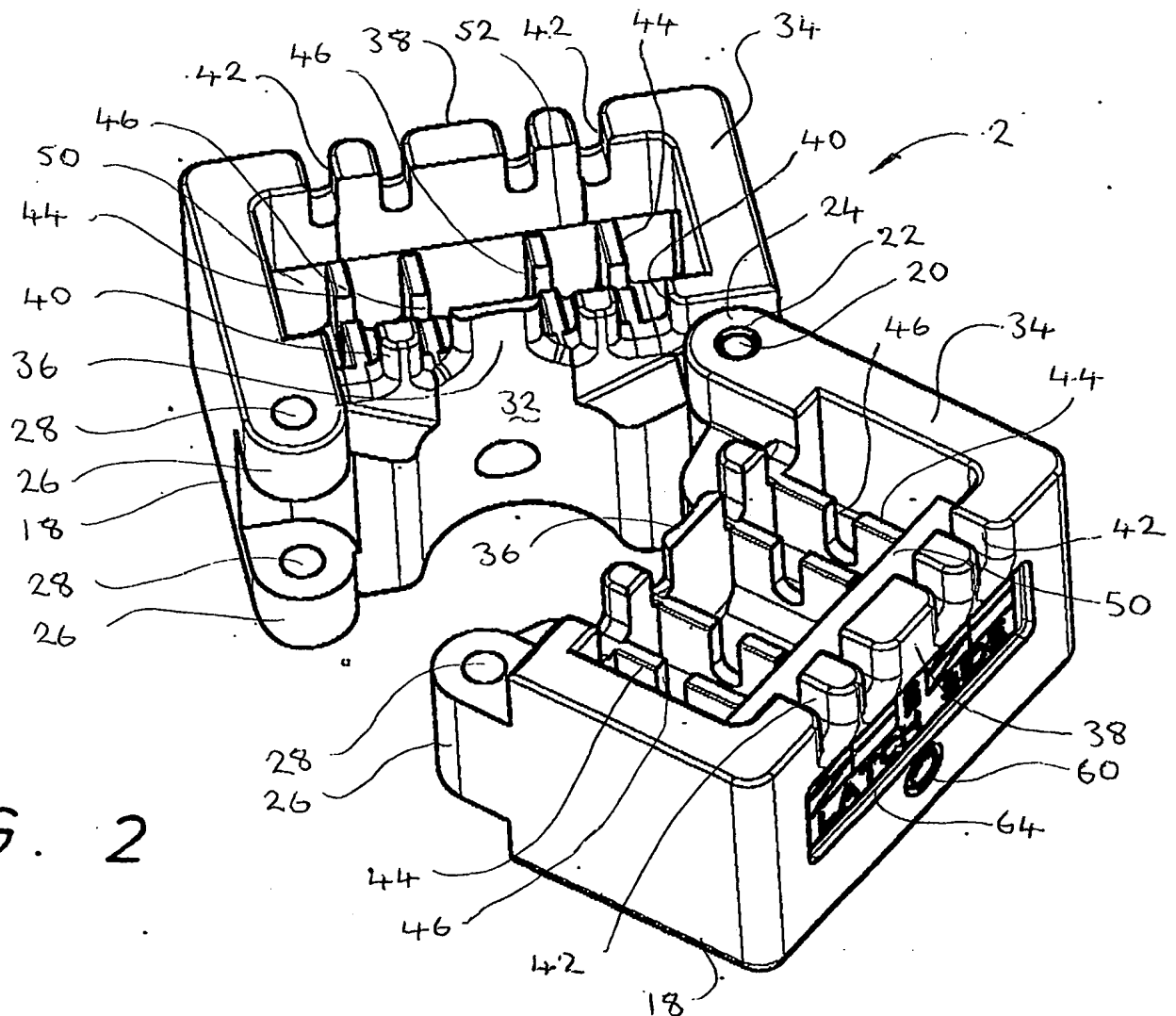


FIG. 2

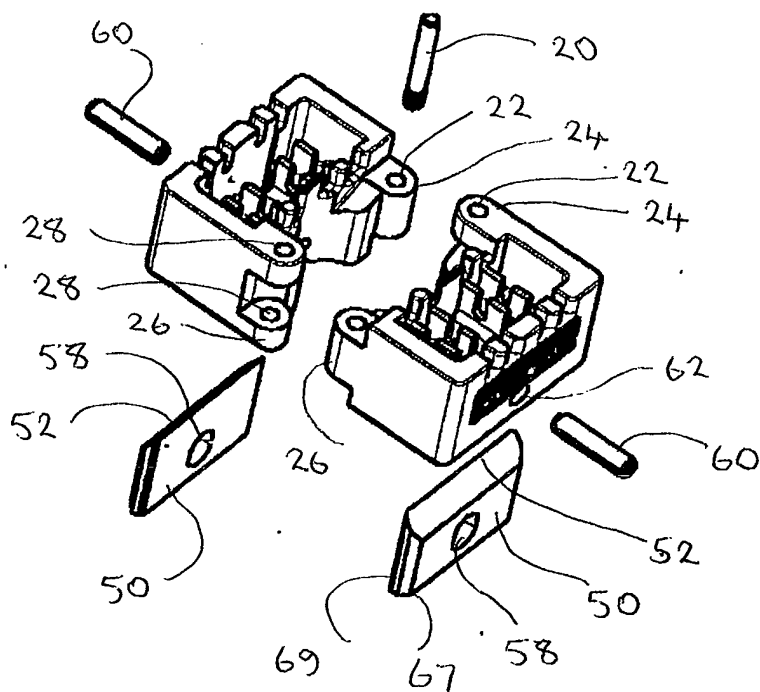
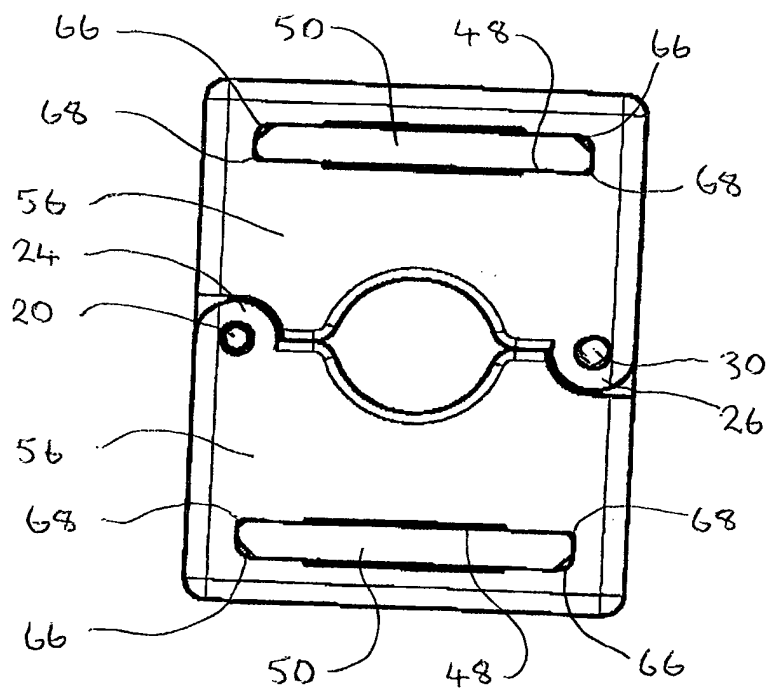


FIG. 3

FIG. 4



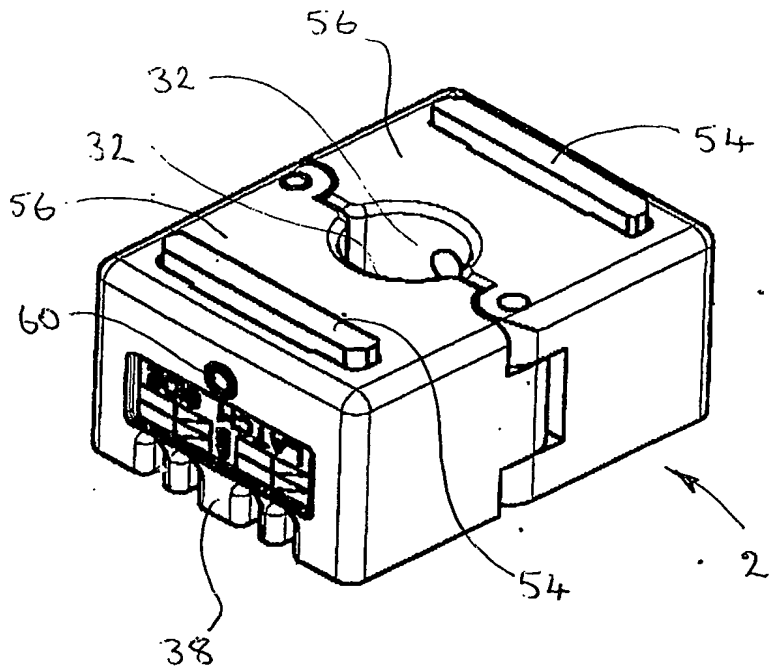


FIG. 5

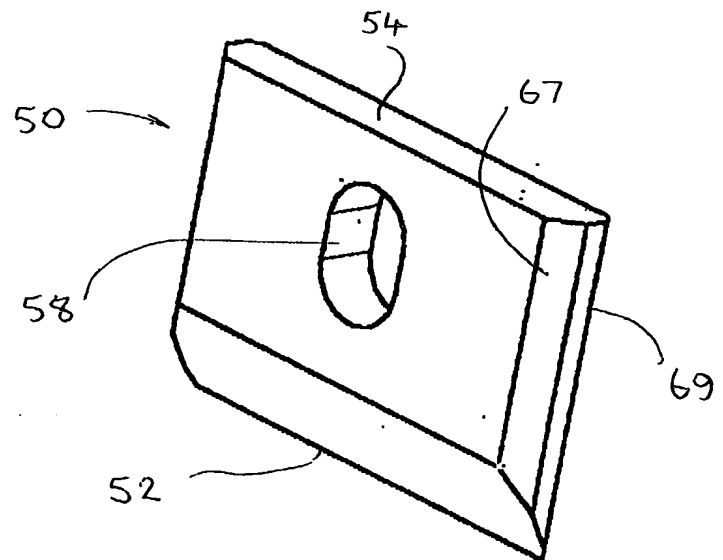
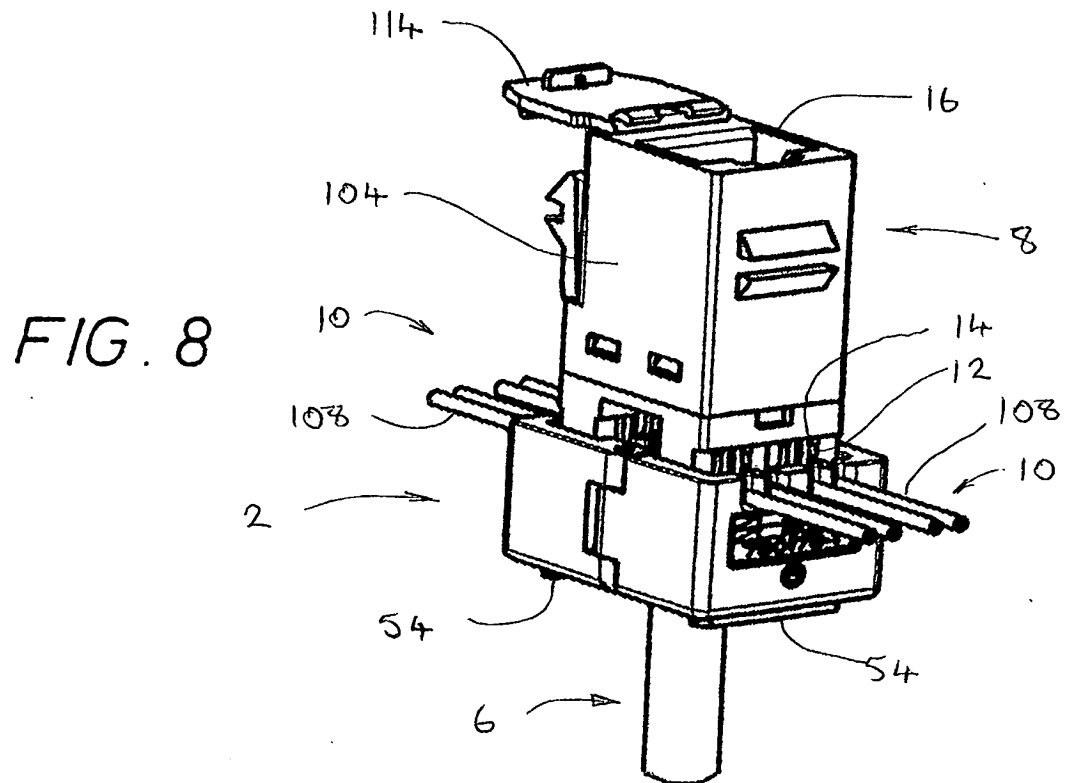
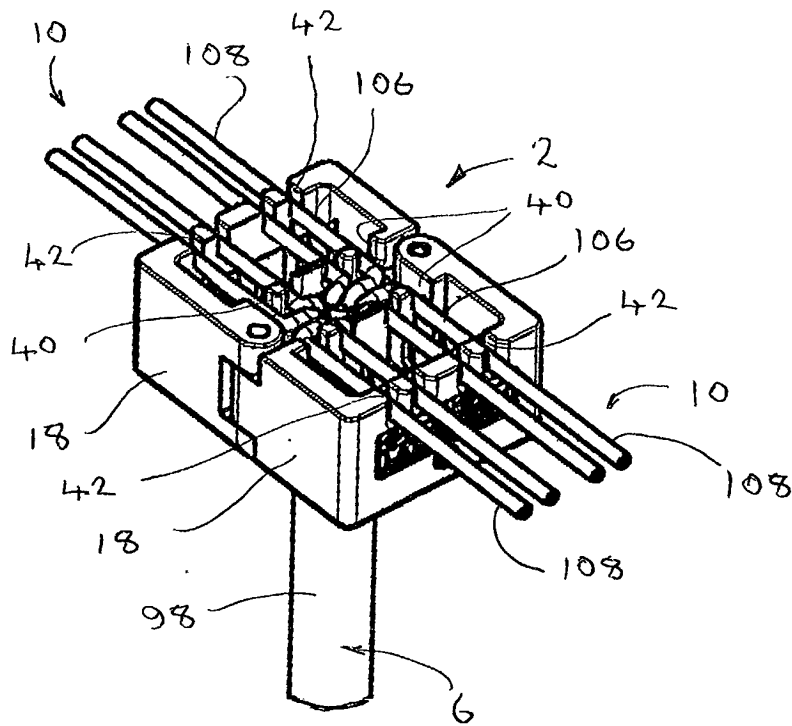


FIG. 6



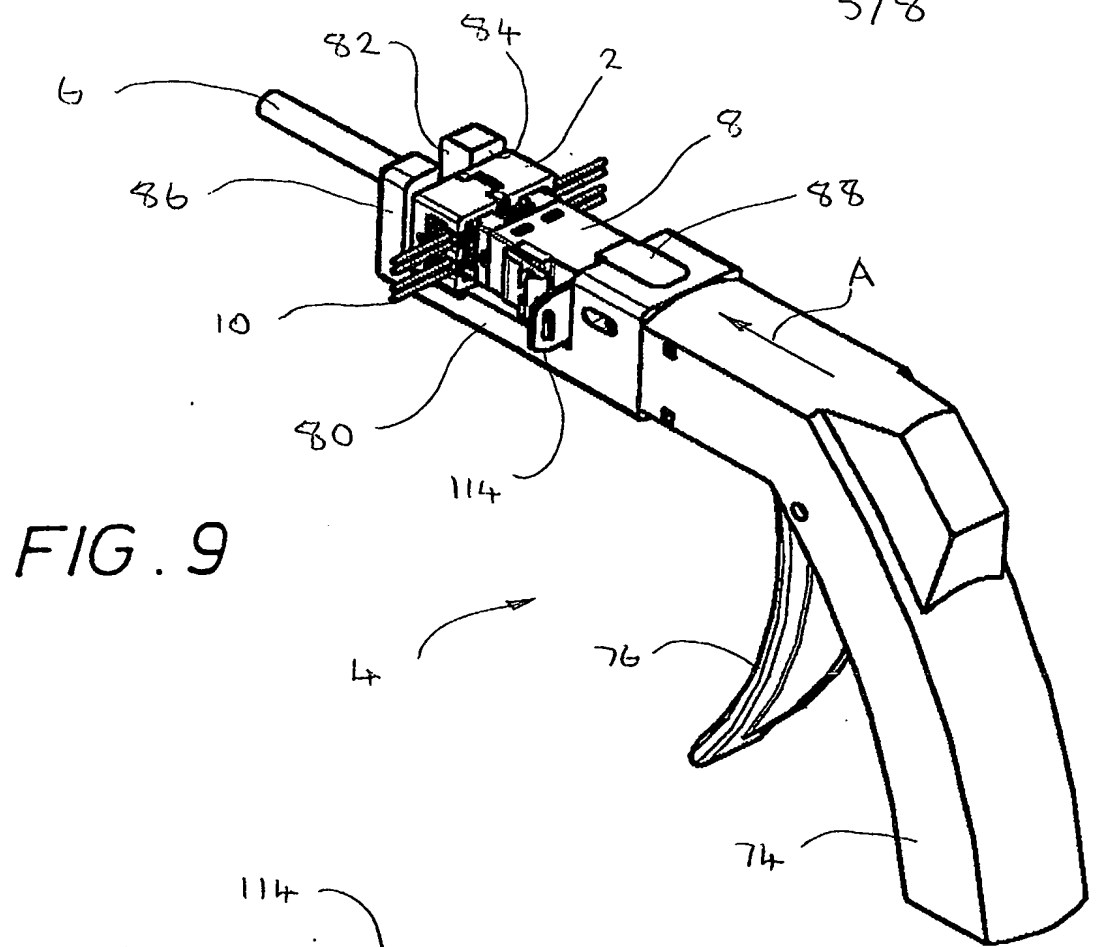


FIG. 9

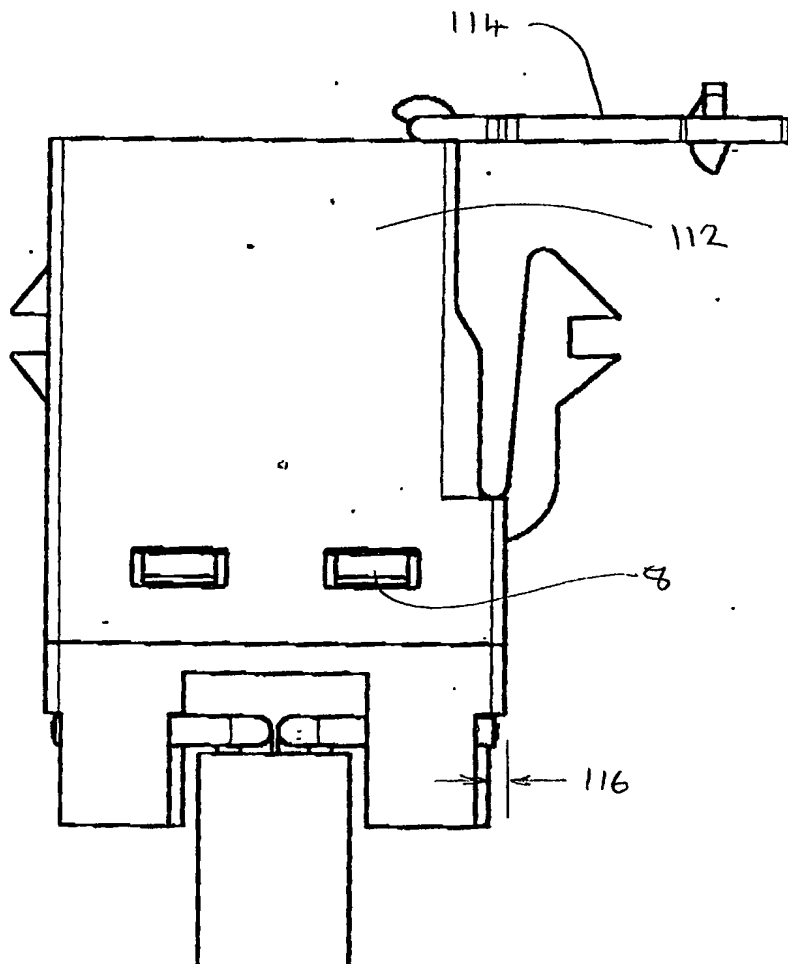


FIG. 10

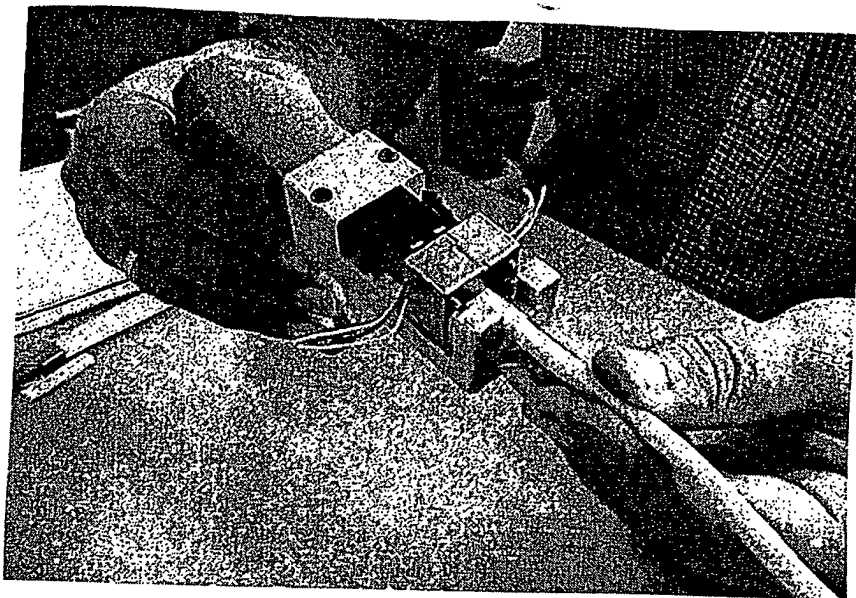


FIG. 11

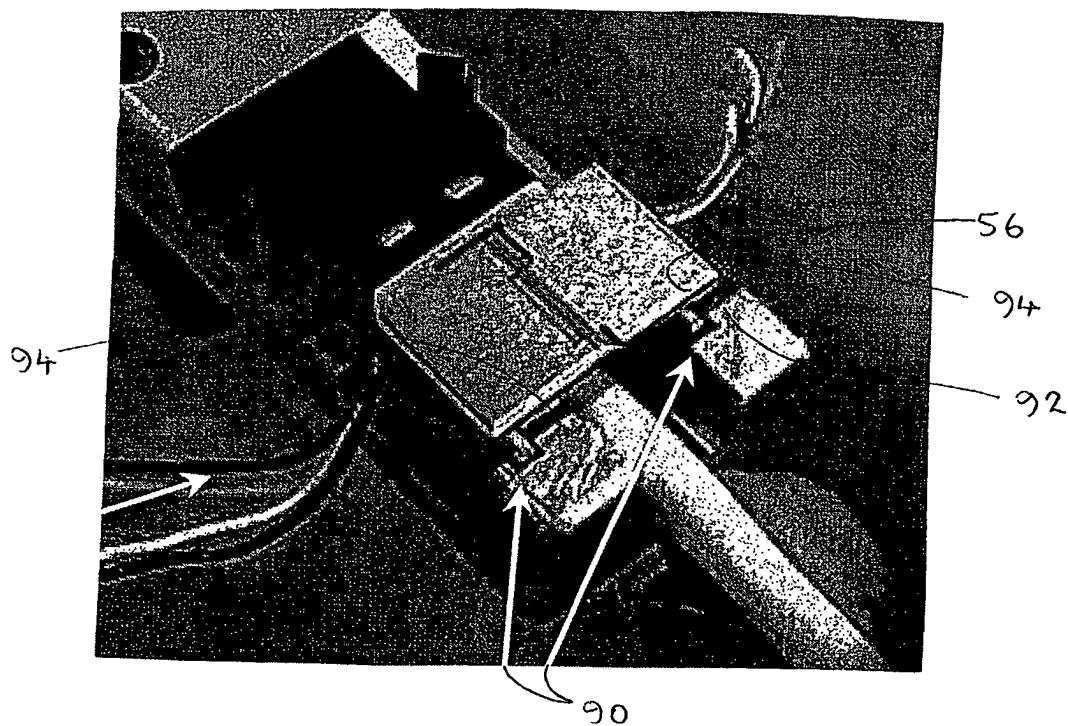


FIG. 12

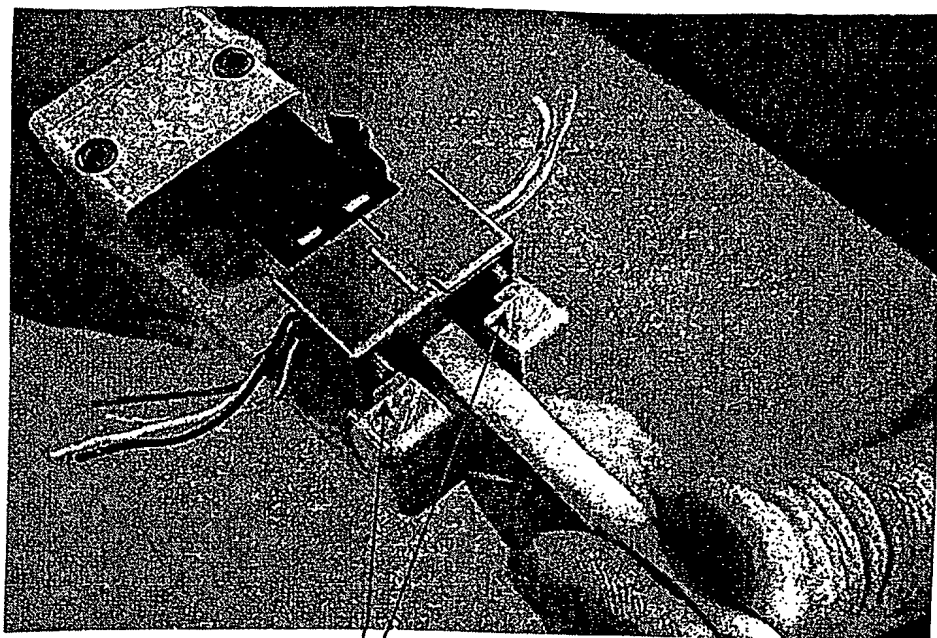


FIG. 13



FIG. 14

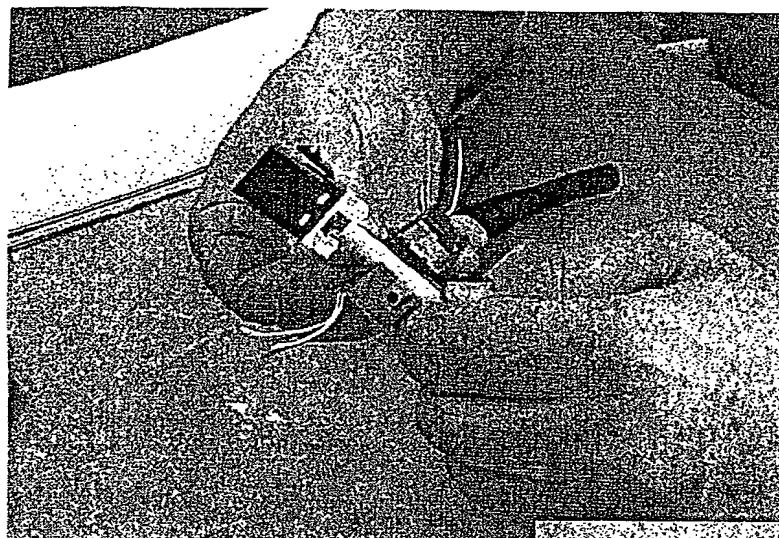
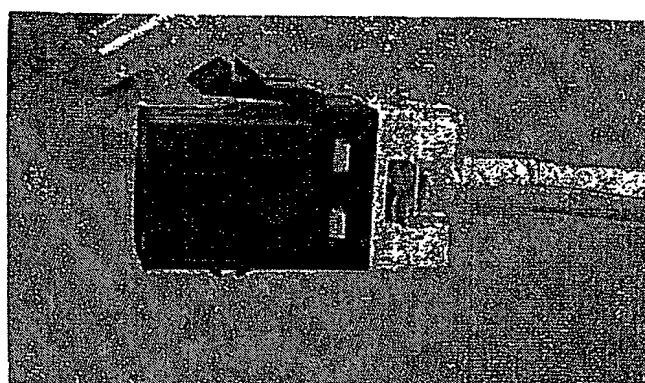


FIG. 15



96

FIG. 16